Introduction to Quantitative Methods

Definitions, Concepts, and Rationale

Why are you here?

- Research
  - Consumers of psychological literature & research
  - Skills applicable to other disciplines as well
- Everyday applications
  - “9 out of 10 doctors…”
  - Election polls
- Pursuit of “truth”
Quantitative Methods

• Quantitative methods = empirical data
  – Administer “measures”
    • “On a 1 to 5 scale (with 1 being not at all and 5 being completely), please rate how depressed you currently feel.”
    – The data for EACH INDIVIDUAL who completes this question will be a value from 1 to 5
      » Individual 1 = 1
      » Individual 2 = 5
      » Individual 3 = 4
      » Individual X = Y
  – One way or another, all data analyzed using quantitative methods is collected in this or a similar fashion

Perspective

• Philosophy
  – Observe the world and draw conclusions
    • Conclusions informed by our perspectives
      – May be adversely impacted by our biases

• Scientific Method
  – Hypothesis → Empirical Data → Results
    • Use quantitative methods to evaluate empirical data which, in turn, informs the results we draw
    • Less biased...

• To be covered in Research Methods
Populations vs. Samples

• Population
  – *Entire collection of events in which you are interested*
    • People, men, women, college students, high-school students, individuals with depression, etc.
    • Example: depression study.
    • Example: SAT scores.
  – Populations can be large (men) or small (living U.S. Presidents)

Populations vs. Samples

• Population
  – Quantitative measures derived from populations are referred to as *parameters*
    • These are the real values we say we’re interested in when we conduct research
    • Note: you MUST, from the beginning, keep clear in your mind which values are *parameters*
  – Even though populations represent the very concept or relationships we’re interested in examining, it is often impractical to collect empirical data on all individuals in a population
    • How can you collect data on ALL depressed individuals?
Populations vs. Samples

• Sample
  – A limited subset of the entire population from which we attempt to infer characteristics about the population
    • NOTE: There are TWO parts to this definition
    • Typically, we use samples to conduct research
  – When we collect subsets of individuals or events from the populations…
    • Random sampling
    • Random assignment

Populations vs. Samples

• Sample
  – Quantitative measures derived from samples are referred to as statistics
    • Because, more often than not, we work with statistics, many people refer to the content of this class as “statistics”
    • Statistics are the estimates of parameters—estimates of the real values we are interested in studying
      – Estimate = imperfect
    • Note: you MUST, from the beginning, keep clear in your mind which values are statistics—don’t confuse statistics with parameters!
Variables

• Variables
  – Defined as an object that can take many different values
    • Example: Gender (Male, Female, …)
    • Example: Depression (Hi, Med, Lo OR 1-63)
    • Example: X (1, 4, OR 567,345,817)
  – Generally, we group the empirical data we collect into variables for further analysis
    • 1 Measure of depression = Depression
    • 10 Summed measures of depression = Depression

Types of Variables

• Discrete Variables
  – Variables that take only a limited number of values
  – Often, these are categories
    • Example: Gender (Male & Female)
    • High School Class: (Freshman, Sophomore, Junior, Senior)

• Continuous Variables
  – Variables that take any value between a high and low point on a scale
    • Example: Age (0 to 100+)
    • Example: Depression score on BDI (0 to 63)
Types of Data

• Measurement (Quantitative) Data
  – *Data derived from measurements*
  – Examples: weight, height, or depression score
  – The focus of this course

• Categorical (Qualitative) Data
  – *Data derived through the grouping of individuals into conceptually meaningful categories*
  – Categorical data often created from quantitative data
  – Example: depressed vs. non-depressed
  – Not a main focus of this course.
    • We WILL need to use categorical data at times, however.

Quantitative Data: Scale Types

• Nominal scales
  – Not *really* scales at all—categories assigned to data
  • Example: Gender (Male & Female)
  • Example: Political Orientation (Rep vs. Demo)

• Ordinal scales
  – A scale ordering individuals or events on a continuum
  • Example: Military ranks (privates have less authority than do captains and captains have less authority than general)
  – However, there is NO indication that the difference in authority between a private and a captain is equal to that between a captain and a general
  – Thus, the order is arbitrary—it’s not based on a measurable quantity
Quantitative Data: Scale Types

• Interval scales
  – Used when we need to talk about differences between points on a scale
  – Most scales in psychological research are interval scales
  – Assume than an equal difference has the same meaning anywhere on the scale
    • The difference between 10º F & 20º F is the same as the difference between 200º F & 210º F -- 10º F

Quantitative Data: Scale Types

• Interval scales (cont.)
  – However, we can’t talk about ratios using an interval scale
    • 40º F compared to 80º F (1:2 ratio)
    • 40º F compared to 20º F (2:1 ratio)
  – However, if F is converted to C…
    • 40º F → 4.4º C & 80º F → 26.7º C
    • 4.4º C compared to 26.7º C (1:6.07)
  – Since, when the temperature scale changes the ratio changes, we obviously can’t say that 40º F is half as hot as 80º F.
Quantitative Data: Scale Types

• Ratio scales
  – A scale with a true zero point (an absence of a quantity) allowing for ratio comparisons
    • Examples: Length, time, & weight
    – 10 lbs twice as much as 5 lbs (2:1)
      • 10 lbs → 4.52 kg & 5 lbs → 2.26 kg
    – 4.52 kg twice as much as 2.26 kg (2:1)

The Use of Variables

• Depending on the way a variable is used in research, we refer to it differently
• Independent variables (IVs)
  – *Any variable manipulated by a researcher used within a study*
  – Example: Experimental vs. Control conditions
  – Sometimes called *predictors*—IVs predict DVs
• Dependent variables (DV$s$)
  – *Variables outside the control of the experimenter*
    • i.e. The data resulting from manipulations of the IV$s$
  – Also known as *criterions*—the value IV$s$ predict
The Use of Variables

- **Example**
  - **IVs**
    - Gender
    - Age
    - Social Support level (High vs. Low)
    - Treatment Group (IPT, CBT, or Control)
  - **DV s**
    - Depression
    - Anxiety
    - Work adjustment

Types of Statistics

- Depending on the goals of our study and analyses, we may wish to use different types of statistics
- **Descriptive statistics**
  - *Describe* the nature and structure of our data (typically, our variables)
- **Inferential statistics**
  - *Infer* qualities of the population from the observed data (prediction & estimation)
Future Directions…

• As you progress through the book, pay particular attention to the diagram on page 11
  – Understanding WHICH test to use is at least as important as knowing HOW to conduct a test
• Refer back to this diagram as the semester progresses